ILLINOIS INSTITUTE OF TECHNOLOGY
Mechanical, Materials And Aerospace Engineering Department

MMAE SEMINAR

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Recipient of MMAE Alumni Recognition Award 2006

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3:30 – 4:30 PM
E1-104

Abstract

"PHYSICS-BASED COMPUTATIONAL SIMULATION OF UNSTEADY SEPARATED FLOWS – A CATALYST FOR FLOW-ADAPTIVE GRID GENERATION

Complex fluid dynamics problems generally display disparate length scales. Even further challenging are problems where the regions of disparate length scales move in space. As numerical simulation resources advance, computational fluid dynamics researchers raise their expectations regarding the complexity of the problems they solve, as well as the accuracy with which these problems are solved. At one time, meeting these expectations was solely the responsibility of the flow equations. Over the past 25 years, the subject of grid generation has emerged as the second pillar sharing this responsibility. Beginning with boundary alignment even for the most complex geometrical configurations, the art and science of grid generation has advanced enormously, such that important physical flow features can now be reflected in the grid itself.

The focus of this talk will be grids adapting to evolving flow features to increase the accuracy of the flow simulation. Further, the adaption will be achieved by r-refinement wherein a fixed number of points are re-distributed in the flow domain, bounded by limiters on the minimum and maximum spacings. The talk will begin with brief remarks on elliptic grid generation, and describe the numerical generation of grids adapted to temporally evolving features in unsteady vortex-dominated flows. The presentation will also consider temporally deforming boundaries, multi-block grids with multi-rectangular computational regions and a corresponding composite solution procedure, and the control of grid structure adjacent to boundaries. Examples of adaptive-grid flow solutions will include stenosed arteries, flow control with vorticity addition, turbomachinery flows, including turbine-blade leading-edge cooling, and mixer flows.